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BARK BEETLE CONDITIONS IN THE CONIFEROUS FORESTS OF FOREST SERVICE REGION 4

NOVEMBER 1960

By

R. I. Washburn and J. A. E. Knopf
Entomologists

DIVISION OF FOREST INSECT RESEARCH
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Reed W. Bailey, Director
Forest Service
U. S. Department of Agriculture
Ogden, Utah

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INTRODUCTION

This report presents current information on infestations of bark beetles in conifer stands on lands of all ownerships in the territory covered by the U. S. Forest Service Region 4. There are at present epidemics of mountain pine beetle in lodgepole and ponderosa pine, Engelmann spruce beetle in Engelmann spruce, Black Hills beetle in ponderosa pine, Douglas-fir beetle in Douglas-fir, and engraver beetles in alpine and white firs in various parts of the region.

Lodgepole pine is found in northern Utah, western Wyoming, and southern Idaho. Engelmann spruce occurs throughout most of Region 4 at various elevations. Ponderosa pine is distributed throughout southern Idaho; an extensive area on the Dixie National Forest, with Panguitch, Utah, being about the center of type; a small area south and east of Manila, Utah; limited amounts on the Manti-LaSal National Forest near Moab, Utah; on Charleston Mountain, Nevada; and on the Toiyabe National Forest near Reno, Nevada, which represents the eastern edge of the east side ponderosa stands of California. Douglas-fir occurs throughout the region. Alpine fir is distributed throughout the region between 3,500 feet and timber line.

Throughout the Intermountain states during the past two years precipitation, particularly during the growing season, has been below normal, with many forested areas suffering from serious drought conditions. Dry seasons such as we are currently experiencing appear to be associated with the following characteristics noted in connection with bark beetle attacks.

In areas where less than normal rainfall has occurred most coniferous species tend to lose some of their ability to successfully pitch out attacking bark beetles. If sap flow is inadequate due to a partial

dehydration of host trees it is easier for the beetles to complete their attacks and for broods to develop without the hinderance of a copious sap flow.

This report is a consolidation of information on bark beetle infestations occuring in Forest Service Region 4 during 1960, as determined from evaluation surveys. The objective of this report is to present the entomological significance of each infestation. A map of Region 4 showing relative position of the infestations and detailed maps of each infestation are appended.

MOUNTAIN PINE BEETLE

Targhee National Forest

The mountain pine beetle has shown definite epidemic tendencies on the Targhee National Forest for the last few years. As these epidemic centers have developed, control action has been initiated. In most cases control efforts have been successful in materially reducing the bark beetle populations.

Aerial detection surveys during the fall of 1960 showed a relatively large infestation of mountain pine beetle building up on Federal and State lands in the vicinity of Moody Creek and Mud Springs. This area is adjacent to the Hawley Gulch infestation that was treated two years ago. Lodgepole pine in larger diameter classes (8 inches and above) were found to be supporting heavy broods. Attacks averaged 15.6 starts per sq. ft. with 94.8 in. of gallery. Broods were healthy in appearance and larvae averaged 205.4 per sq. ft. on September 29,1960. An estimated 2,000 acres contain approximately 3,000, 1960 attacked trees. At the time entomologists made their evaluations, a decided lack of predators and parasites was noted. All of these facts indicate an increasingly serious situation.

In the course of ground checking, a small area of infestation was found on forest land northeast of heavily hit lodgepole pine stands around Sheridan Reservoir. Attacked trees were found in groups and as scattered singles between Taylor and Snider Creeks. It is estimated that 100 to 150 trees are currently infested. Forest lands north of Sheridan Reservoir could possibly be infested by beetles being spread by winds, and in the past small outbreaks have occurred periodically adjacent to the Sheridan Reservoir epidemic centers. Close surveillance should be kept to detect future outbreaks of this nature.

The infestation in the vicinity of Sheridan Reservoir, near Kilgore, Idaho, continues to show epidemic tendencies. Early spring investigations showed that large numbers of beetle brood survived the winter.

Because of the threat posed by this infestation, a cooperative Federal, State, and private control program was started immediately after the spring investigations. Due to the intensity and epidemic tendency of this infestation, additional control work should be done unless, of course, the trend should reverse itself due to unusual climatic conditions. Certainly biological agents are presently insufficient to cause an immediate reversal of the trend.

Grand Teton National Park

It was reported in 1959 that mountain pine beetle activity had steadily increased since 1955 in Grand Teton National Park in spite of effective treating programs. This year, entomological appraisals show that beetle populations are still increasing at an accelerated rate. A decided lack of predators and parasites, unusually favorable weather conditions for brood development, and an abundance of suitable host material are probably the factors responsible for increased numbers of trees being attacked this year.

One new attack center was detected during aerial surveys on the south slope of Pilgrim Mountain. This unit was heavily hit and ratios of red tops to new attacks were as high as 1:10. Brood density, inches of gallery, and number of gallery starts varied throughout the epidemic center, but in every case indicated epidemic tendencies. This particular infestation was divided into 4 strata on the basis of apparent variation in brood density. In the two areas showing the lowest brood density (around 180 per sq. ft.) there were fewer attacks and inches of gallery than in the two areas showing brood density above 200 per sq. ft. of bark surface.

All units experienced an increase in numbers of new attacks except Two Ocean Lake, Donoho Pt., and Jackson Lake.

Summary of population density data for
mountain pine beetle infestations in lodgepole pine

Unit	Area in acres	No. of infested trees	Brood density sq. ft.	Gallery starts	In. of gallery
Pilgrim Mtn.	600+	1,500+	206.6	7.6	44.4
Signal Mtn.	2,000	7,000	215.2	16.4	128.8
East Signal Mtn.	800	800	193.6	11.2	104.8
Two Ocean Lake	1,000+	100	No fall data recorded		
Donoho Pt.	300	300	" "	" "	
Jackson Lake	600+	300	" "	" "	
Totals	5,300	10,000 ± 2,000			

Woodpecker populations that have been relatively active in the past appear to have dropped off in all units. Insect predator and parasite populations were light in all of the units that were biologically evaluated. With this in mind we feel that a continuation of the treating program is warranted on all units.

Teton National Forest

The Teton National Forest has been treating epidemic centers of mountain pine beetles each year since 1956. In some centers the beetle population has been reduced sufficiently that control action is not now necessary. There are areas, however, where additional treatment is desirable.

Several new areas of infested lodgepole pine were found during the course of aerial detection surveys. For the most part, attacked trees were within or adjacent to old known infestation centers. One new area containing over 200 attacked trees was found on the east side of Pacific Creek. Station entomologists determined that the buildup of old trees (red tops) to new attacks (attacked 1960) was 1:6. This, coupled with heavy broods, indicates that beetle populations have an explosive potential to infest surrounding stands of mature to overmature lodgepole pine.

Another new infestation is on Pilgrim Mountain. This infestation is on both Grand Teton National Park and the Teton National Forest. It is estimated that approximately 500 of the 2,000 infested trees are on the national forest (see Grand Teton National Park writeup).

Other areas where fading was observed from the air are: Deer Ridge, W. Shoal Creek, Granite Creek, Spread Creek, Lost Creek, Ditch Creek, Antelope Mountain, and the Hoback Rim.

Most of the infested lodgepole in the vicinity of Hoback Rim occurs south of Highway 189 on State and private land where an estimated 1,000 attacked trees are currently fading. Evaluations showed relatively high brood counts and the over-all indications point toward increasing mountain pine beetle activity on this unit. This area has a past history of persistent mountain pine beetle activity and further losses are to be expected if mature and overmature trees are not harvested.

Entomological appraisals in all infested centers showed an increasing trend. Red top to new attack ratios in all cases were 1:1 or more, and in most instances a greater than 1:1 ratio was the rule. Also, the relative abundance of predators and parasites has dropped considerably. It was determined that mountain pine beetles are generally on the increase throughout the Teton National Forest.

Wasatch National Forest

Since 1958, control efforts have been concentrated on a massive outbreak of mountain pine beetle infesting lodgepole pine stands on the north side of the Wasatch National Forest. Treating has been effective during the past three years in reducing the over-all beetle populations and has materially reduced the size of the epidemic area. In the areas not treated to date the buildup ratio has increased sharply; attack intensities of 20 trees or more per acre are not uncommon. Also, infested trees that were left untreated in areas treated only once had the potential of infesting 2-5 trees in the succeeding year. This points out the need to cover each area at least twice. Unfortunately, the over-all biological potential of the beetle remains at an extremely high level. Biological evaluations this past season have shown that insect predator and parasite populations remain at an ineffective level. Woodpecker populations are increasing but they cannot conceivably exert enough biological pressure to curb the rapidly rising beetle populations. This picture is further complicated by the fact that an extremely dry summer has provided favorable conditions for the mountain pine beetle. Therefore, we feel certain that losses will continue at an accelerated rate unless the beetle population is drastically reduced through treatment or widespread winter kill.

This year, an estimated 500 lodgepole pines were attacked by mountain pine beetle in the Provo River drainage. Entomologists found that brood densities were not alarmingly high, but they still presented a threat to the recreational values of this high use area. Forest crews planned to treat these trees this fall.

An infestation on Iron Mine Mountain was picked up during aerial surveys in the fall of 1958. Since that time Station entomologists have made periodic evaluations in the area. Although brood densities declined slightly from 1959 to 1960, the attack potential has remained high due to favorable weather and scarcity of natural enemies. This year an estimated 1,200 to 1,500 trees are infested.

Two other small areas were evaluated. Approximately 50 lodgepole pine are infested with mountain pine beetle in the Smith Morehouse drainage. There is a possibility that the remaining lodgepole pine could be attacked, therefore, treatment of this infestation could be justified to preserve the recreational area.

Gardner Fork was also looked at and it was found that the majority of infested trees were pole size. Mountain pine beetles have a relatively hard time establishing broods in trees this size and it is doubtful that this infestation will become serious.

Ashley National Forest

Mountain pine beetle activity has been observed on the Ashley National Forest since 1956. Several infestations have not developed epidemic tendencies and consequently have been left to run their course, while others, such as Pole Creek, developed into epidemics. Direct control measures reduced the beetle population in Pole Creek to a level where direct control is no longer necessary.

Infestations in the following areas caused concern in 1960. Brown Duck Creek, Miners Gulch, and Bear Wallow.

Infested mature and overmature lodgepole pine are scattered throughout the pole size timber in Brown Duck Creek. This infested area covers approximately 2,000 acres and the Ashley National Forest personnel estimate 2,000 newly attacked trees. Entomologists' evaluations show a 1:2 buildup ratio occurred in 1959 with the present population indicating a somewhat static trend. An additional biological evaluation is planned for next spring to reassess the potential and trend of this infestation.

Currently 600-700 lodgepole pine are infested on approximately 100 acres in Miners Gulch. This area is partially isolated but insect populations could eventually threaten adjacent lodgepole and ponderosa pine stands. Evaluations in the spring of 1961 should provide more accurate data to determine if a treating program is needed.

There are approximately 1,200 infested trees on national forest land and 500 on the Uinta-Ouray Indian Reservation in the Bear Wallow area. This infestation is in a mixed age type with considerable lodgepole pine of which approximately 60 percent are poles, 30 percent mature trees, and 10 percent overmature trees. Biological evaluations show a greater brood density than in Brown Duck Creek, but still below epidemic level. However, a potential exists that might result in explosive conditions in the future.

The infestation detected several years ago in Lake Creek, near the junction of Oweep Creek appears to be increasing in size and intensity. Unfortunately, we have not been able to make a fall evaluation of this infestation so definite biological information is not presently available.

The old infestation in Hells Canyon that we have watched for several years appears to have remained relatively static. This infestation is located in the scattered groups of mature lodgepole distributed throughout the pole-size timber in the Hells Canyon-Cow Creek area. This infestation should be checked each year to determine its potential. If epidemic tendencies develop this infestation could represent a threat to the mature timber in and around Flea Flat and the Yellowstone drainage.

Toiyabe National Forest

The aerial detection survey of the Toiyabe National Forest revealed no new bark beetle outbreaks of any consequence. The Charleston Mountain district appeared exceptionally free of recently faded bark beetle trees.

The Crystal Bay infestation, on the north shore of Lake Tahoe, persists with the beetle population density and parasite-predator relationship at about the same level as last year. The Crystal Bay Development Company, the new owners of the Crystal Bay area, are concerned about the infestation and are taking steps to reduce the loss of timber caused by the beetle. Their program is being handled without Federal financial assistance. Briefly, the program involves the removal of infested trees and a general thinning of the stand in the areas being developed for houses, shops, etc. There is a possibility that some infested trees will be removed next year in areas not scheduled for immediate development.

Sawtooth National Forest

Active infestations of mountain pine beetle have been chemically treated for the past three years. Larger and older infestations were located primarily within the South Fork, Boise River drainage. Smaller and less intensive outbreaks developed in 1959 within the Warm Springs Creek and Woods River drainages.

Chemical control of these infestations has reduced the beetle population and trees per acre attacked to a satisfactory level. Present indications are that only a maintenance type program will be required in 1961.

Boise National Forest

The second year of control by the cut, deck, and burn method has reduced mountain pine beetle populations in second-growth ponderosa pine, near Atlanta, Idaho, to a low level. Some maintenance control might be required in 1961, depending on results of operational surveys. Biological evaluations were not conducted in the fall of 1960 due to the lack of infested trees for sampling.

Dixie National Forest

In last year's report it was noted that Black Hills beetle populations showed a definite downward trend in ponderosa pine stands. This year biological evaluations show that for the most part beetle populations are continuing to decline. Southern Utah ponderosa pine stands, in the past few years, have been subjected to severe drought conditions and past records have shown that Black Hills beetle outbreaks often coincide with drought conditions. A situation such as this warrants continued surveillance to detect any new infestation centers, and some additional control on the few remaining hot spots is advisable.

DISCUSSION

In 1959, twenty-two infestation centers were reported in lodgepole pine stands of Region 4. Twenty of these areas were treated during the 1960 season, and nearly all will need additional control in 1961. This year ten new infestation centers were found, most of which were in close proximity to older known infestations. All but two of these areas were found during the course of annual aerial detection surveys, some of which show a population potential indicating a serious upward trend.

For the most part, control in treated areas was effective. However, increased numbers of trees were infested during the 1960 flights. This can be explained by considering the following factors: (1) Because of the large size of some areas it was physically and financially impossible to cover the entire area of infestation. (2) Drought has weakened trees sufficiently so that fewer attacking beetles succeed in killing trees that, under normal conditions, might survive. (3) Predators and parasites have been at a low level in most infestation centers. (4) More beetle brood has survived. (5) New infestation centers have been found.

Following this section a table giving forest, unit, and brood densities is presented. Brood densities generally were lighter during the 1960 season than in 1959. One might wonder how the over-all trend of mountain pine beetle populations can continue its upward swing when brood densities appear to be below last year's averages. Even though the 1960 brood densities are lighter than in 1959, in most cases they remain above densities expected under epidemic conditions. The answer does not lie wholly in the interpretation of attack and brood numbers which are but one facet of a biological evaluation. The entomologist faces a highly challenging situation in interpreting intangible factors such as over-all influence of weather, presence or lack of parasite-predator complexes and/or other biotic agents. All are taken into consideration for formulating predicted trends.

Mountain Pine Beetle in Lodgepole and Second-growth Ponderosa Pine

Unit	DBH	Brood density	Gallery starts	Inches of gallery	Trend
		(Per square foot)			
Targhee					
Mud Springs	13.6	211.6	15.6	94.8	Increasing
Taylor-Snider Crs.	15.0	180.4	11.6	79.0	"
Sheridan Reservoir		(no fall data recorded)			"
Grand Teton National Park					
Pilgrim Mtn.	12.6	206.6	7.6	44.4	Increasing
Signal Mtn.	11.7	215.2	8.2	128.8	"
East Signal Mtn.	13.4	193.6	11.2	104.8	"
Two Ocean Lake		(no fall data recorded)			Static
Donoho Point		(no fall data recorded)			Decreasing
Jackson Lake		(no fall data recorded)			"
Teton					
Pacific Cr.	12.9	216.3	7.1	69.9	Increasing
Hoback Rim	12.7	193.2	6.2	87.2	"
Wasatch					
Provo River	12.6	170.4	2.0	18.6	Decreasing
Iron Mine Mtn.	15.9	191.6	5.4	47.2	Increasing
Wasatch Project	13.2	203.6	9.2	130.4	"
Ashley					
Brown Duck Cr.	12.8	128.0	3.0	38.8	Static
Miners Gulch	10.4	179.6	4.4	46.8	Increasing
Bear Wallow (forest)	14.0	138.0	2.4	42.8	(Static to
" " (Indian land))		198.0	5.2	54.8	(increasing)
Lake-Oweep Cr.		(no data recorded)			Increasing
Hells Canyon		(no data recorded)			Static
Sawtooth					
Sawmill Cr.	9.0	217.8	14.4	94.8	Decreasing
*Vienna Cr. Flats	12.9	78.0	10.0	69.8	"

Black Hills Beetle in Ponderosa Pine

Dixie - (pooled data from all sampling units)					
	20.3	94.6	-	-	Decreasing

*1960 flights were not completed at time samples were taken.

ENGELMANN SPRUCE BEETLE

Bridger National Forest

Since 1955 a combination of control measures consisting of logging, trap trees, and toxic chemicals have been directed against a highly persistent infestation of Engelmann spruce beetles in the upper Green River area. Late in July of 1960, biological evaluations were made in this area and Station entomologists found extremely heavy brood densities in all areas examined. All life stages of the beetle were sampled. Representative brood data are given for three areas as follows:

	Brood density/sq. ft.	Gallery starts/sq. ft.	Inches of gallery/sq. ft.
No. Gypsum Cr.	428.4	10.0	44.4 (standing trees)
Moose Cr.	447.6	16.6	81.2 (cull pieces and decked logs)
Moose Cr.	425.6	7.4	32.0 (standing trees)

The data show the highly aggressive nature of the beetle in its 1960 attacks. One- and two-year generation strains were found in all areas examined from Jim Creek to Moose Creek.

It was reported last year that predators and parasites were increasing in the areas subjected to two or more years of treatment. This year this trend seems to be reversing itself with the exception of woodpeckers. Currently, woodpeckers are on the increase but it is doubtful that they can keep up with rapidly increasing beetle populations.

Aerial detection surveys revealed that attacks have occurred in almost all of the remaining susceptible spruce type from Jim Creek to Moose Creek. Also, new areas of fading showed that infestations have progressed far down the slopes leading into the Green River Lakes.

The present infestation presents a threat to all spruce stands immediately adjoining this infestation. From the entomological viewpoint, it appears that the beetle population in this infestation should be reduced as rapidly as possible to prevent tremendous loss of Engelmann spruce.

Uinta National Forest

On June 30, 1958, Intermountain Station entomologists were called on to evaluate an apparently serious infestation of Engelmann spruce beetle on the Uinta National Forest. At that time it was determined that epidemic populations of the beetle were present and immediate control action should be undertaken to prevent widespread destruction in this valuable spruce stand.

The main area of infestation in 1958 was concentrated in the Soapstone drainage of the Uinta National Forest. Fringes of this infestation overlapped parts of the Ashley and Wasatch National Forests. All areas were effectively treated under a cooperative program involving the three forests.

Recommended suppression measures were mainly of two types: (1) Immediate logging of infested trees. (2) Chemical control of infested inaccessible standing trees and stumps, cull pieces and tops in cutover units. These methods were supplemented by use of felled trap trees in some areas that were either removed or treated after the flights were completed.

Recent biological evaluations of the spruce beetle-infested areas pointed up the following facts:

1. Standing tree attacks were at a minimum.
2. Predators and parasites, especially dipterous parasites of the genus Medetera, were increasing rapidly.
3. Good mortality was obtained on all treated units.
4. Logging operations are continuing to remove infested material at a rapid rate. If broods continue the observed downward trend, it is expected that only maintenance type control will be necessary in 1961.

It should be pointed out that through a control program properly carried out, an extremely destructive Engelmann spruce beetle epidemic has been brought under control in a relatively short period of time.

Ashley National Forest

This year, two small Engelmann spruce beetle infestations were treated in the Hell Hole and McAffe Basin drainages. Additional control may be necessary if new hot spots are detected.

Payette National Forest

In 1958, the Payette National Forest reported a possible buildup of Engelmann spruce beetle within the Fisher Creek timber sale which lies in the heart of the spruce type on the forest. The infestation was evaluated and evidence showed that both one- and two-year generation strains of the beetle were present.

Chemical control of the beetles within stumps, slash, cull logs, and of trap trees felled, reduced the Fisher Creek infestation.

The selective cut timber sale in Brown Creek failed to produce an increase in beetle populations. However, this sale was primarily a fir cut, with a minimum of spruce involved.

Between these two areas, Brown and Fisher Creeks, spruce logs were cold-decked from a road right-of-way between Goose Lake and Hazard Lake. These logs were heavily infested in 1959. Trap logs were laid down and absorbed some of the beetle population in 1960. However, these cold decks were so large that more than enough beetles remain to represent a potential buildup of beetles that could attack standing trees if the population is not reduced by next fall.

The spruce blowdown areas reported in last year's report in Lick Creek and Elk Creek summits did not produce beetle infestations of any consequence.

Manti-LaSal National Forest

Since 1958, control operations have been carried out against Engelmann spruce beetle populations in Dark and Unknown Canyons on the east side of Mt. Peale near Moab, Utah. The infestation involves lands of Federal, State, and private ownership.

The infestation originally started in culls, stumps, and long butts where spruce stands were being selectively cut and logged on State and private lands. Several thousand standing trees were attacked in 1957 and 1958. Since then, logging and chemical control measures have substantially reduced the infestation. In 1960, some chemical treating, along with burning decked material, was carried out by Forest Service crews on Federal land.

This year, selective logging operations are continuing on State land. Consequently, a considerable amount of slash is on the ground at the present time. It must be concluded that some of the trees left in the cutover areas may be windthrown, and if they fall in shaded areas, may be filled in by spruce beetles. If the slash and cull material is not disposed of in some effective manner, Engelmann spruce beetle populations could build up rapidly and cause another serious epidemic.

DISCUSSION

In 1959, nine infestations of Engelmann spruce beetle were reported in Region 4. Control operations were carried out against six of the infestations. The other three were small and did not show an increasing trend. Control methods utilized logging, application of toxic chemicals, and trap tree felling and subsequent treatment. In some infestations a combination of all three methods was used.

Control operations this year were conducted on the Bridger, Uinta, Ashley, Manti-LaSal, and Payette National Forests.

From the entomological viewpoint there is urgent need for continued control action on the Bridger spruce beetle outbreak. It now appears the most desirable action would be an all-out effort aimed at complete control of the infested area in the shortest time possible. Some additional control action may be necessary to complete the programs on the Uinta, Ashley, and Manti-LaSal infestations.

Two real problem areas exist that may cause trouble in the future. They are: The State lands involved in the Manti-LaSal project and the cold decked logs on the new road in the Goose Lake-Hazard Lake areas on the Payette National Forest. These areas will be watched closely so that the land managers can be notified promptly if control action becomes necessary.

DOUGLAS-FIR BEETLE

Annually, large volumes of Douglas-fir in Forest Service Region 4 are killed by the Douglas-fir bark beetle. Generally speaking, the Douglas-fir bark beetle is now quite active throughout the region. Douglas-fir stands on the Sawtooth and Dixie National Forests are particularly hard hit, with many large epidemic centers present on both forests. On the Targhee, Wyoming Division of the Bridger, Teton, Boise, and Payette National Forests damage is less intense than on the Sawtooth and Dixie but many infestation centers are present. On the other hand, some forests containing Douglas-fir stands are relatively free of Douglas-fir beetle. These are the Wasatch, Ashley, Salmon, Challis, and the Manti Division of the Manti-LaSal. Losses from Douglas-fir beetle are expected to continue at about the same level next year. Of course, fluctuations will occur with some infestation centers showing an upward trend in beetle population while others are expected to decrease.

FIR ENGRAVER BEETLES

Many thousand true firs are killed annually throughout the Intermountain region. A number of factors are involved in this mortality. The majority of true firs are killed by the fir engravers, Scolytus ventralis Lec., or Dryocoetes confusus Sw. Ground examination is required to determine the causal agent involved since it is not possible to separate causes of mortality from the air. The majority of the affected trees occur in rather inaccessible areas and are of relatively low economic value. Due to these facts and the large number of more pressing epidemics in need of evaluation, only infestations in those areas showing immediate high value, such as National Parks, were visited this year.

KEY TO BARK BEETLE INFESTATIONS

Mountain Pine Beetle ✓

Targhee National Forest
1. Moody Creek-Mud Springs
2. Sheridan Reservoir

Grand Teton National Park
3. Pilgrim Mountain (Park and Forest)
4. Signal-East Signal Mountain
5. Two Ocean Lake
6. Donoho Pt.-Jackson Lake

Teton National Forest
7. Pacific Creek
8. West Shoal Creek to Granite Creek
9. Spread Creek-Lost Creek
10. Antelope Mountain
11. Hoback Rim

Wasatch National Forest
12. Wasatch Project
13. Provo River-Iron Mine Mountain
14. Smith Morehouse drainage and Gardner Fork

Ashley National Forest
15. Brown Duck Creek
16. Miners Gulch
17. Bear Wallow (Forest & Indian land)
18. Lake Fork
19. Hells Canyon-Cow Creek

Toiyabe National Forest
20 Crystal Bay

Engelmann Spruce Beetle ✓

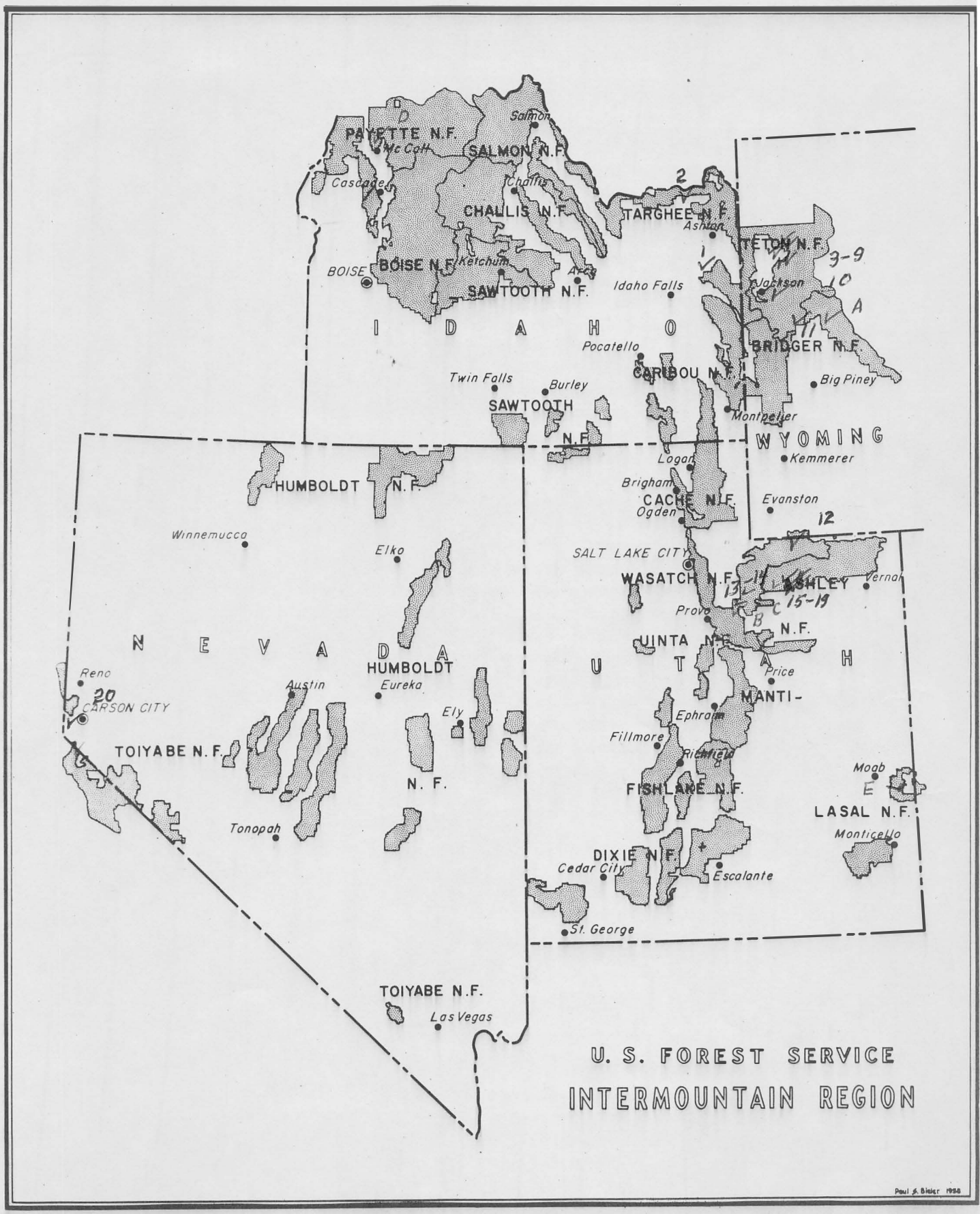
Bridger National Forest
A. Green River Project

Uinta National Forest
B. Uinta Project

Ashley National Forest
C. Hell Hole-McAffe Basin

Payette National Forest
D. Fisher Creek to Goose Lake-Hazard Lake

Manti-LaSal National Forest
E. Dark Canyon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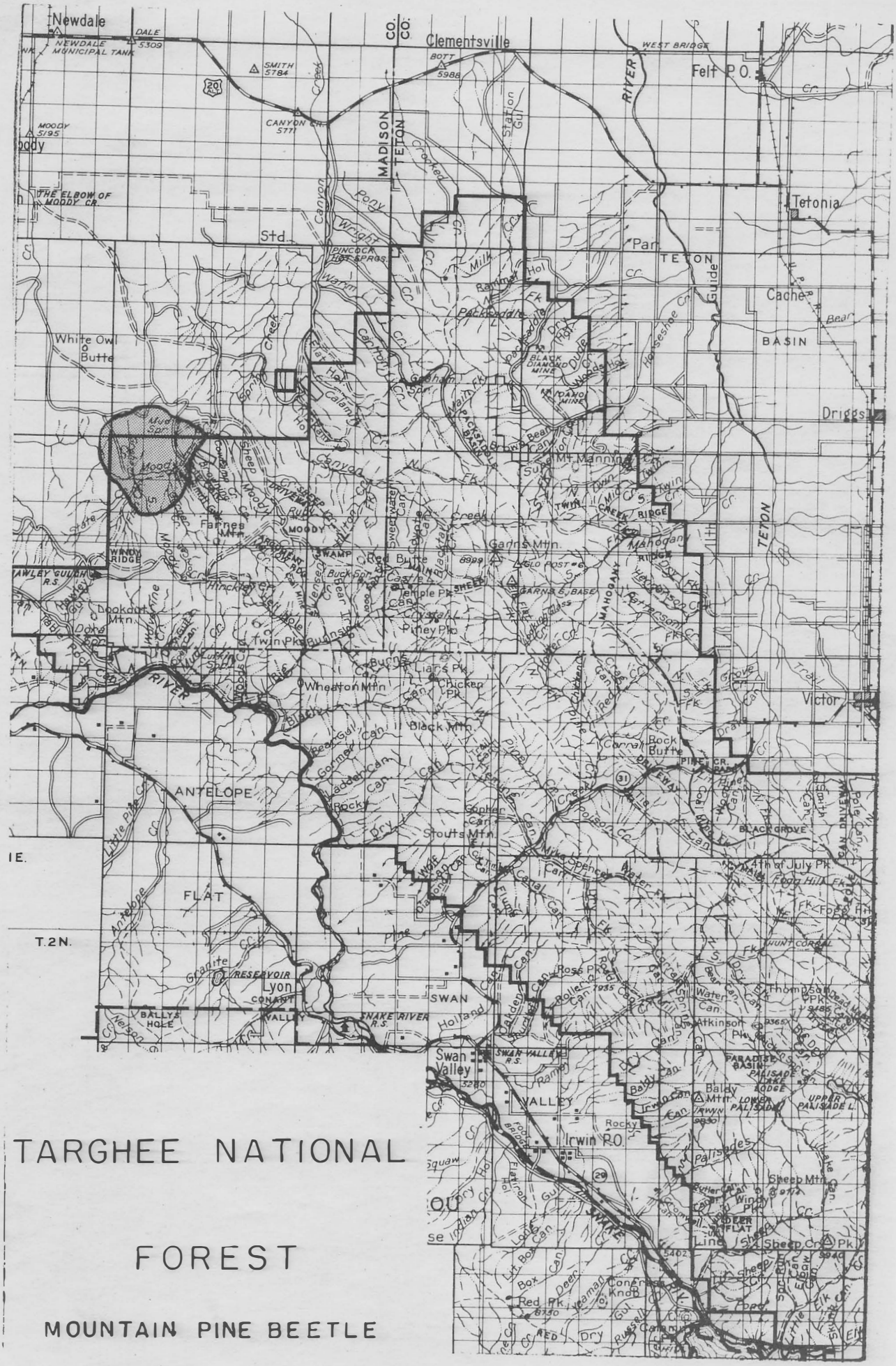
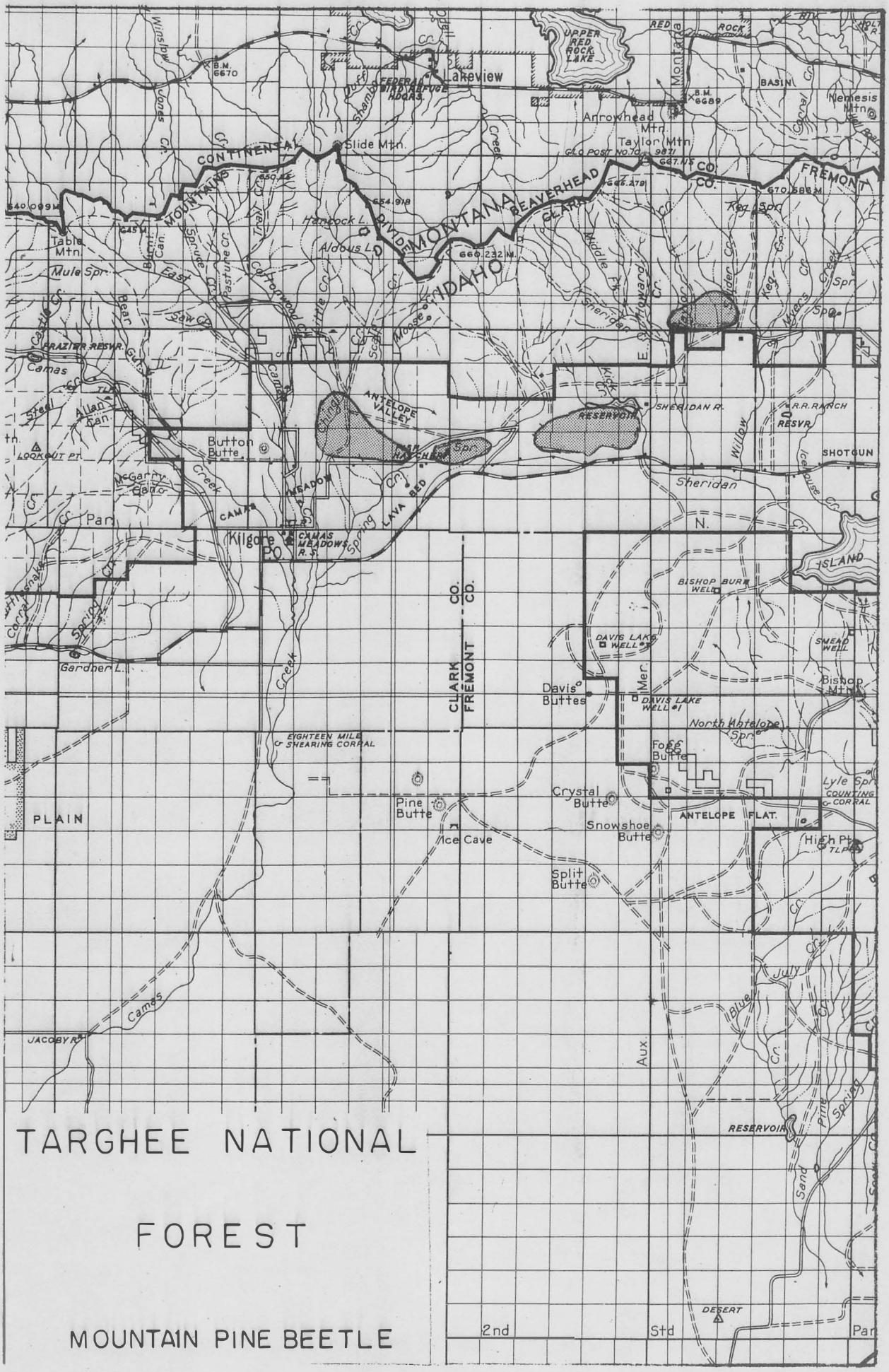
Salmon
Mc Call
SALMON N.F.
Cascade
Challis
CHALLIS N.F.
TARGHEE N.F.
Ashton
TETON N.F.
BOISE
BOISE N.F.
Ketchum
SAWTOOTH N.F.
Idaho Falls
Jackson
I D A H O
Pocatello
BRIDGER N.F.
CARIBOU N.F.
Twin Falls
Burley
Big Piney
SAWTOOTH N.F.
Montpelier
WYOMING
Kemmerer
HUMBOLDT N.F.
Logan
Brigham
CACHE N.F.
Evanston
Ogden
Winnemucca
Elko
SALT LAKE CITY
WASATCH N.F.
ASHLEY N.F.
Vernal
Provo
N E V A D A
HUMBOLDT
U T A H
UINTA N.F.
Reno
Austin
Eureka
Price
MANTI-
CARSON CITY
Ely
Ephraim
Fillmore
TOIYABE N.F.
Richfield
Moab
N. F.
FISHLAKE N.F.
LASAL N.F.
Tonopah
Monticello
DIXIE N.F.
Cedar City
Escalante
St. George
TOIYABE N.F.
Las Vegas
U. S. FOREST SERVICE
INTERMOUNTAIN REGION
Paul S. Bixler 1958



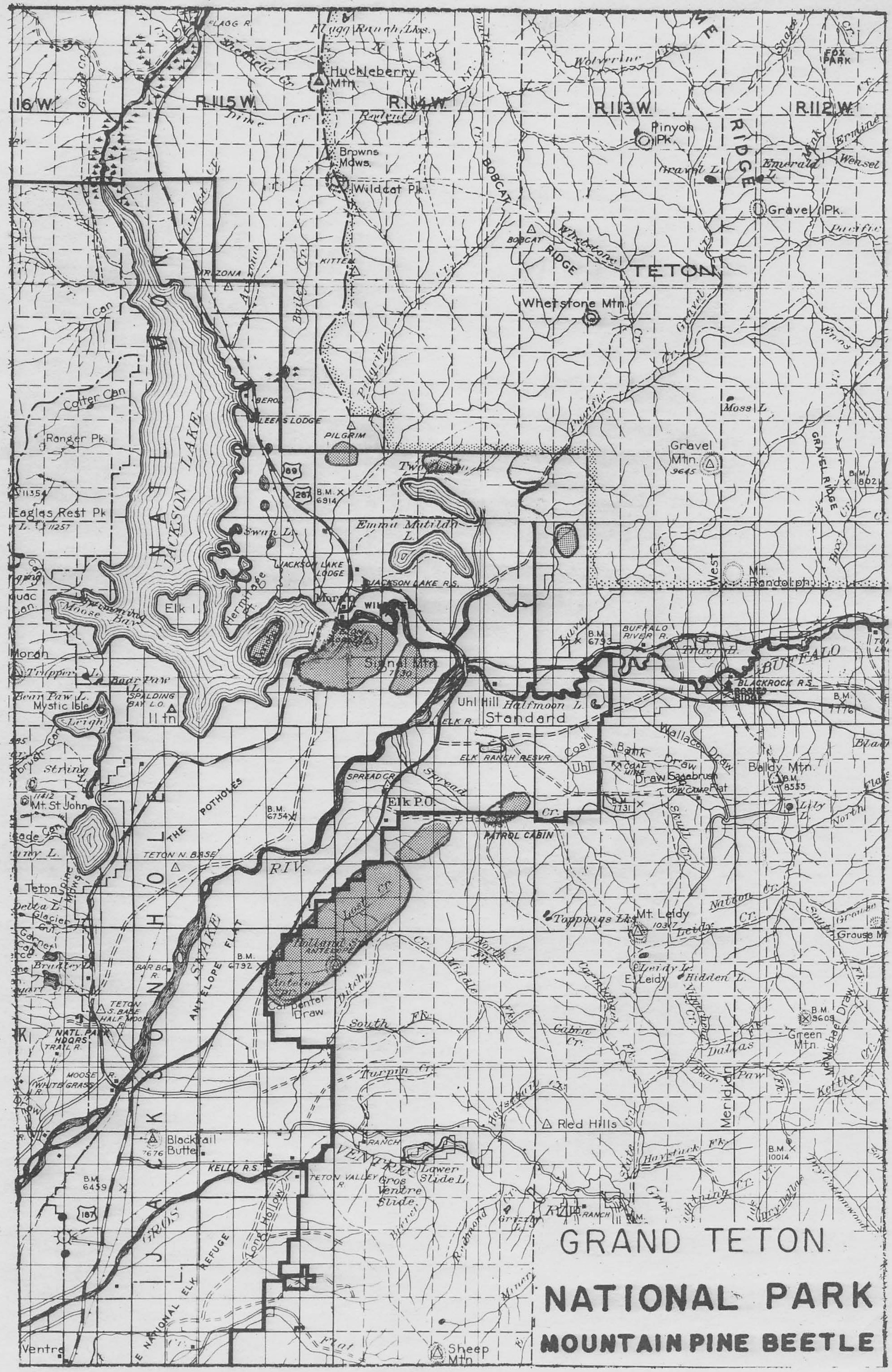
TARGHEE NATIONAL FOREST

MOUNTAIN PINE BEETLE



TARGHEE NATIONAL FOREST

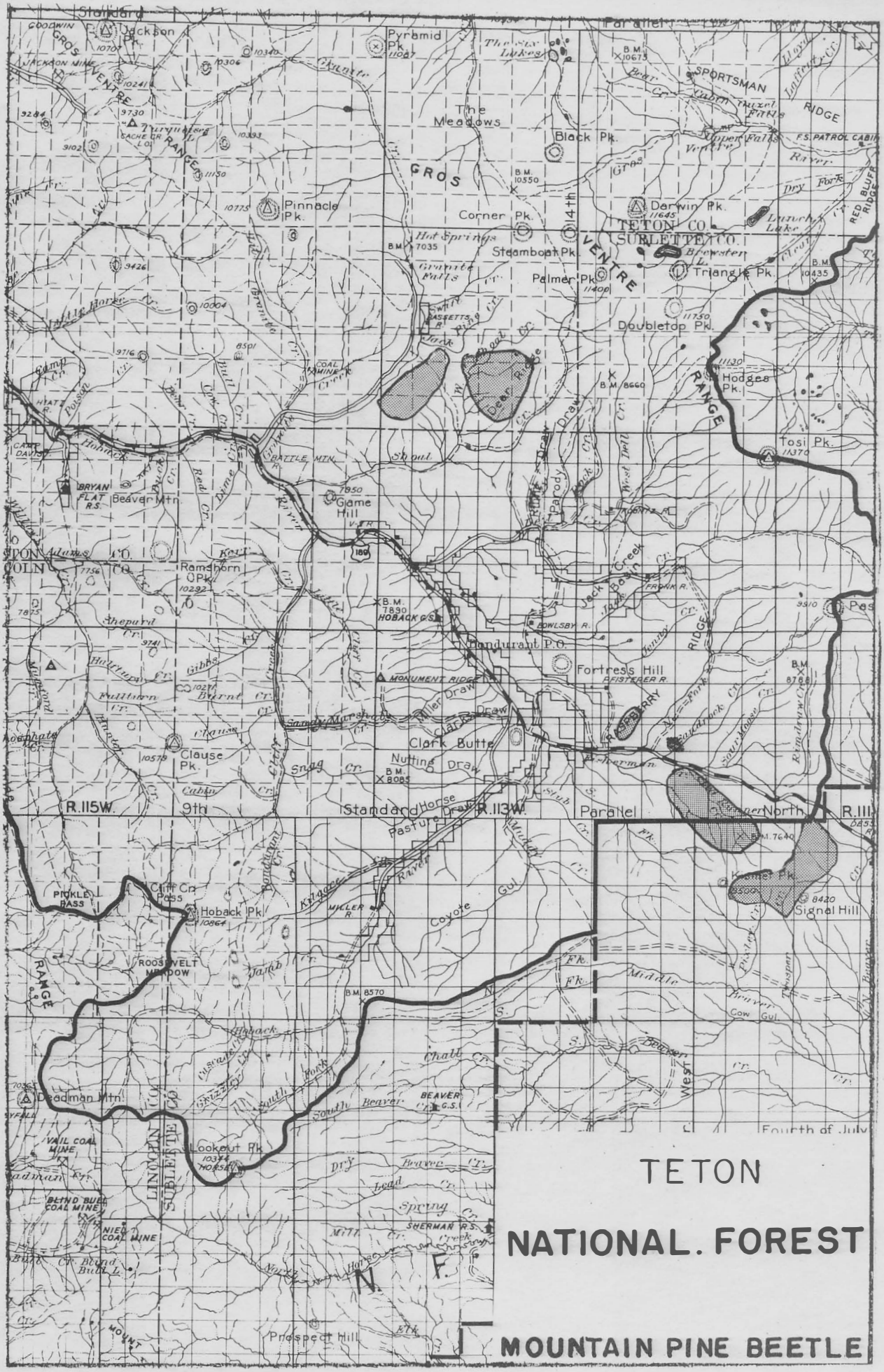
MOUNTAIN PINE BEETLE

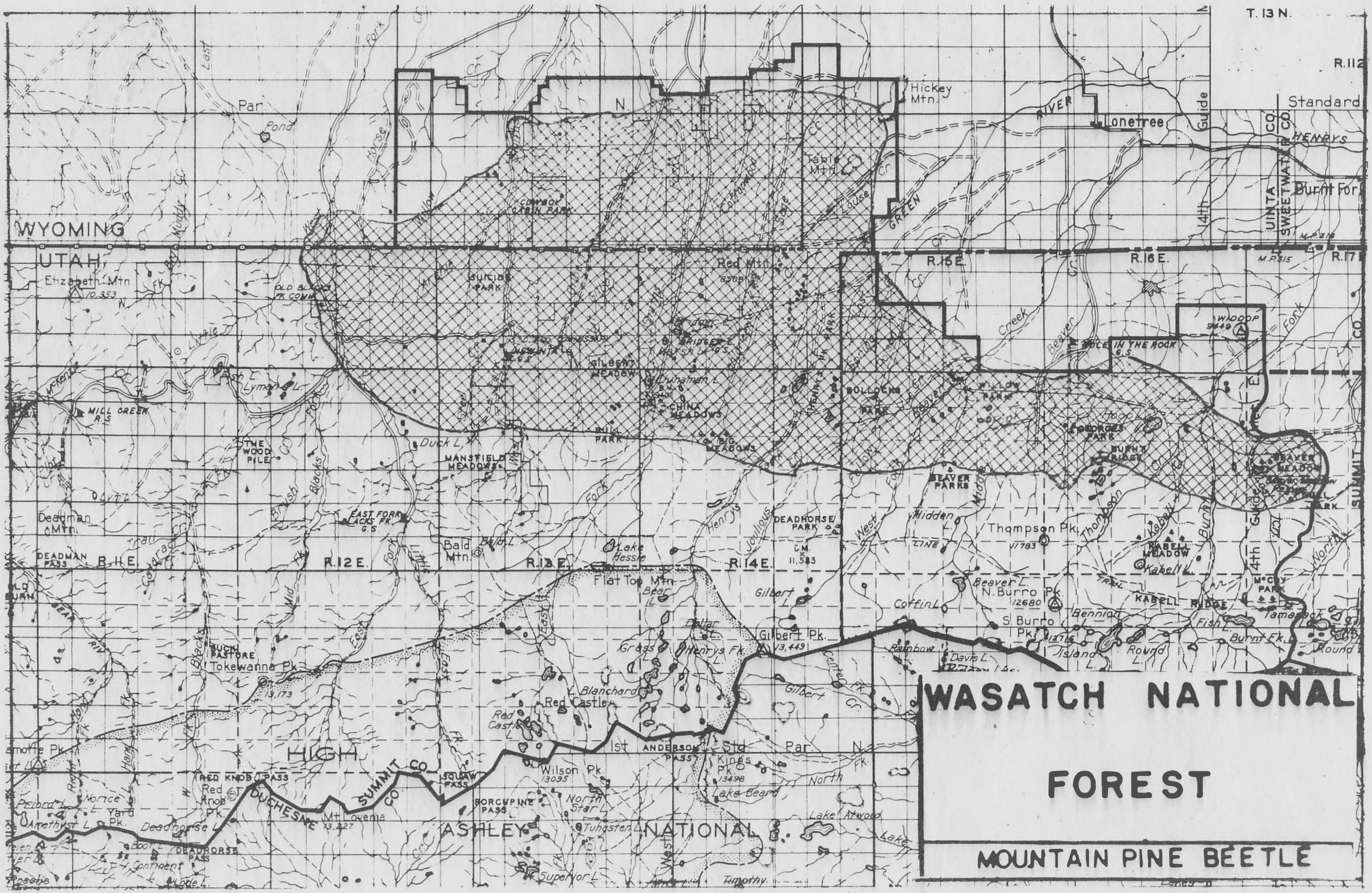


GRAND TETON

NATIONAL PARK

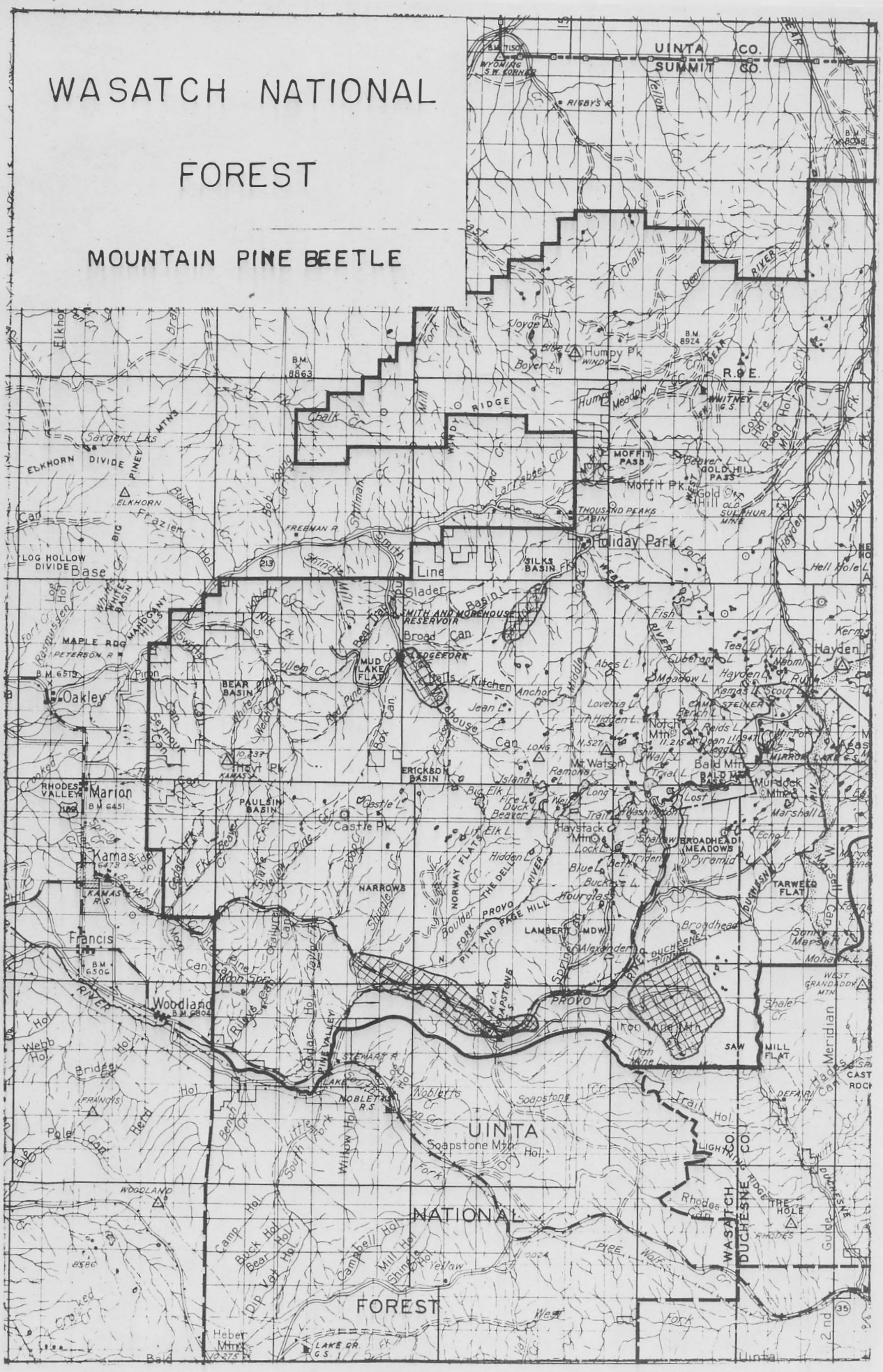
MOUNTAIN PINE BEETLE

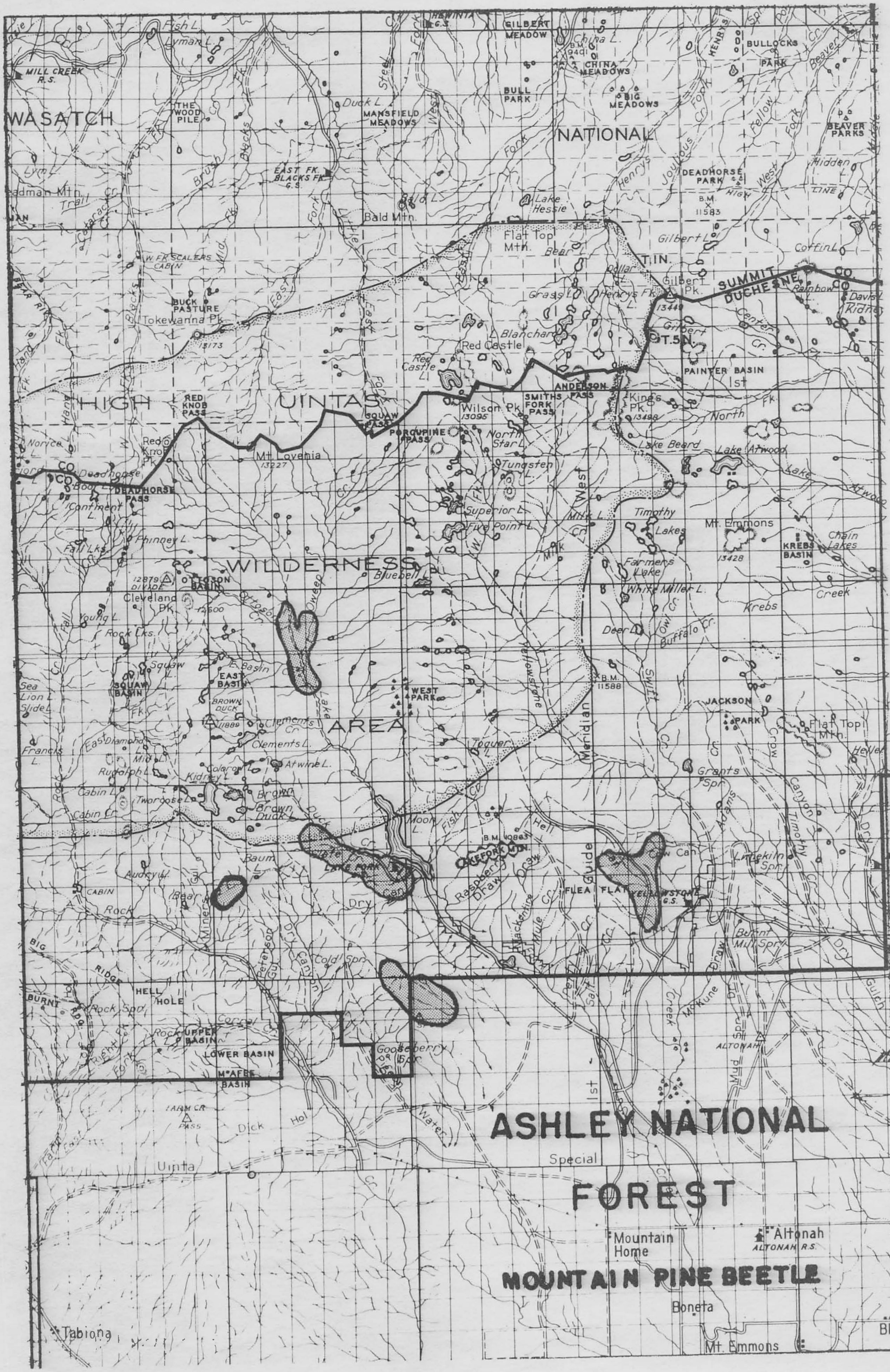

TETON
NATIONAL. FOREST
MOUNTAIN PINE BEETLE


WASATCH NATIONAL FOREST
MOUNTAIN PINE BEETLE
T. 13 N.
R. 112
WYOMING
UTAH
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
R. 16 E.
R. 17
Hickey Mtn.
Lonetree
Standard
Burnt Fork
HENRYS
GREEN
RIVER
UINTA CO
SWEETWATER CO
SUMMIT CO.
Table Mtn.
Red Mtn.
Elizabeth Mtn 10,353
Deadman Mtn.
DEADMAN PASS
Bald Mtn.
Flat Top Mtn
Thompson Pk. 11783
N. Burro Pk 12680
S. Burro Pk.
Gilbert Pk. 13,449
Tokewanna Pk. 13,173
Red Castle
Wilson Pk. 13095
Kings Pk 13498
Mt Lovenia 13,227
Red Knob Pk.
RED KNOB PASS
SQUAW PASS
PORCUPINE PASS
DEADHORSE PASS
ANDERSON PASS
DUCHESNE CO
SUMMIT CO
HIGH
ASHLEY NATIONAL
COWBOY CABIN PARK
SUICIDE PARK
GILBERT MEADOW
CHINA MEADOWS
BIG MEADOWS
BULL PARK
MANSFIELD MEADOWS
THE WOOD PILE
MILL CREEK R.S.
EAST FORK BLACKS FK. G.S.
DEADHORSE PARK
BULLOCKS PARK
WILLOW PARK
BEAVER PARKS
GEORGES PARK
BURNT RIDGE
BEAVER MEADOW
KABELL MEADOW
KABELL RIDGE
McCOY PARK
HOLE IN THE ROCK G.S.
WIDDOP 9449
BUCK PASTURE
Lake Hessie
Duck L.
Lyman L.
Beaver L.
Coffin L.
Davis L.
Island L.
Round L.
Lake Atwood
Superior L.
North Star L.
Amethyst L.
Deadhorse L.

WASATCH NATIONAL FOREST

MOUNTAIN PINE BEETLE

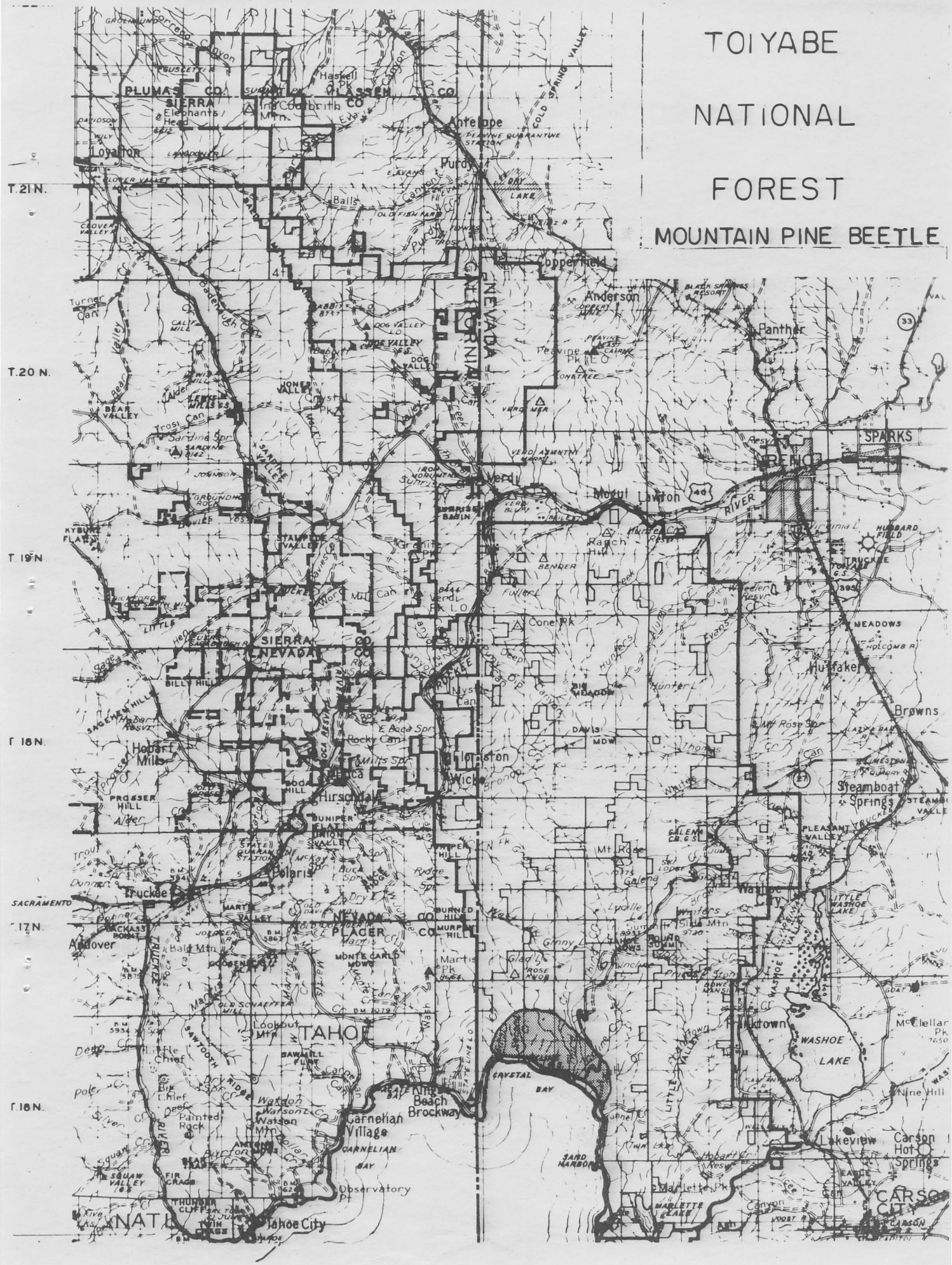


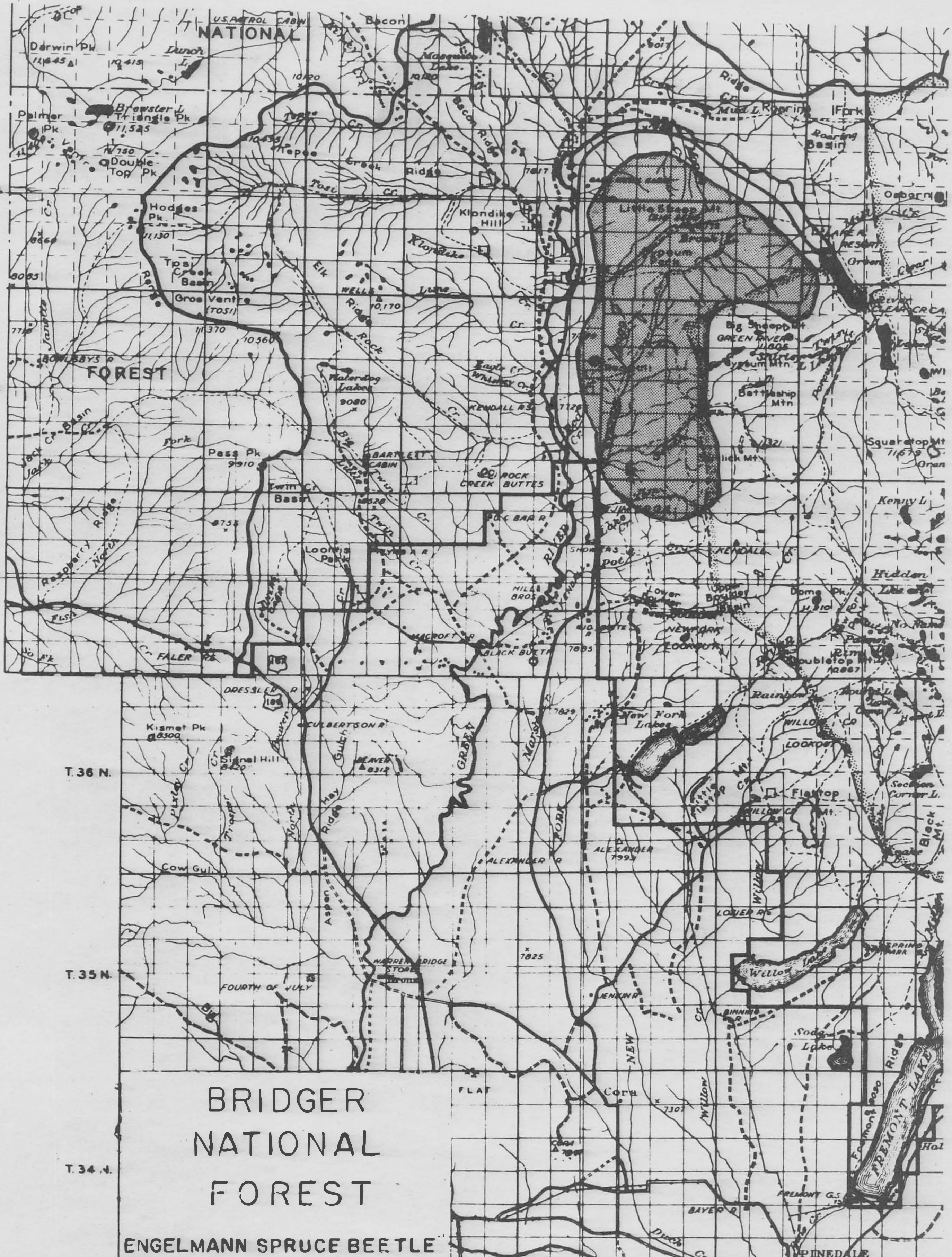


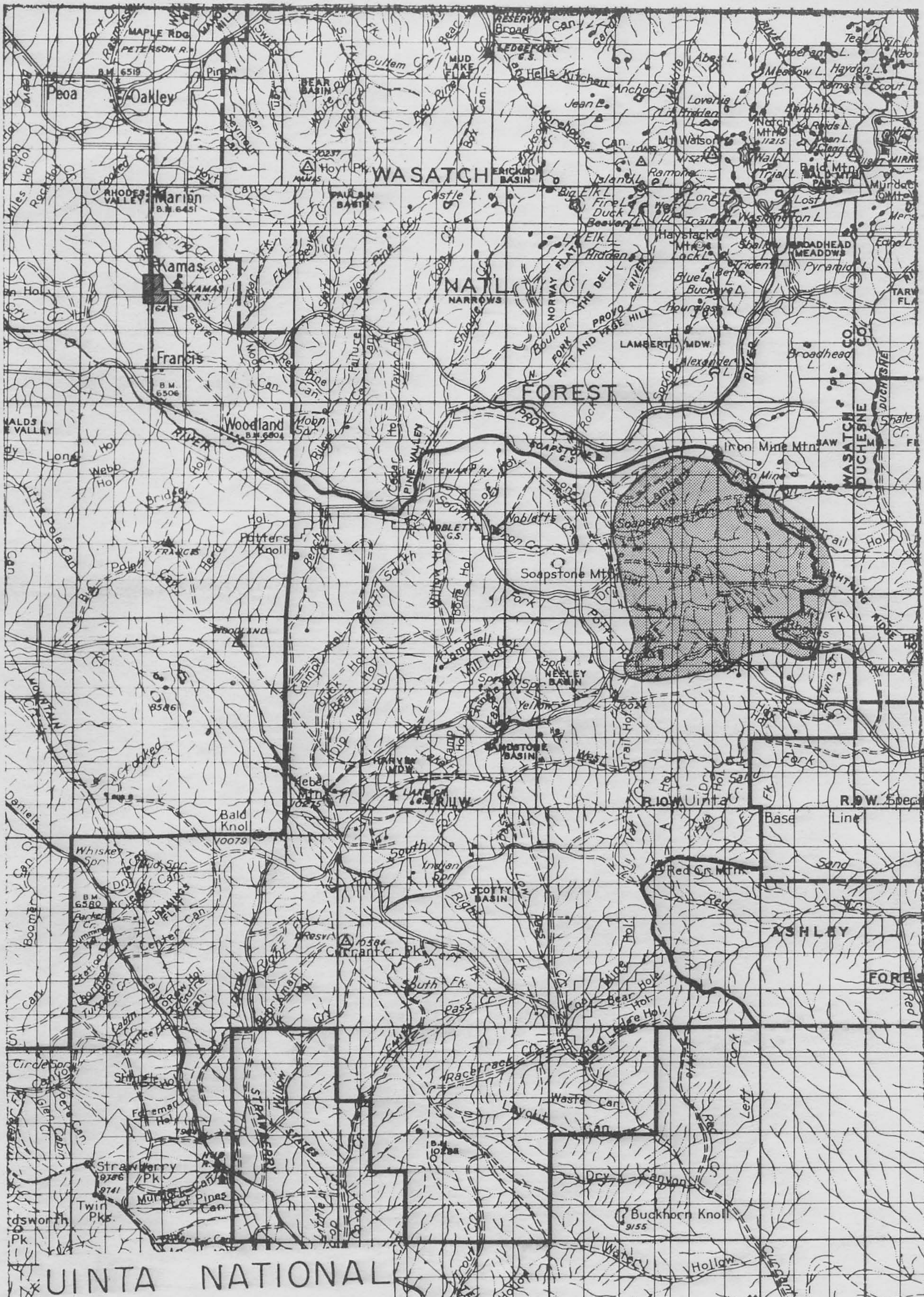
ASHLEY NATIONAL FOREST
Special
MOUNTAIN PINE BEETLE
WASATCH
NATIONAL
HIGH
UINTAS
WILDERNESS
AREA
SUMMIT CO.
DUCHESNE CO.
T.1N.
T.5N.
Meridian
Mill Creek R.S.
Gilbert Meadow
China Meadows
Bull Park
Big Meadows
Bullocks Park
Beaver Parks
Mansfield Meadows
The Wood Pile
Deadhorse Park
Bald Mtn.
Flat Top Mtn.
Tokewanna Pk.
Red Castle
Wilson Pk.
Kings Pk.
Gilbert Pk.
Painter Basin
Red Knob Pass
Squaw Pass
Porcupine Pass
Smiths Fork Pass
Anderson Pass
Deadhorse Pass
Mt. Lovenia
Mt. Emmons
Krebs Basin
Chain Lakes
Cleveland Pk.
Ottoson Basin
East Basin
Squaw Basin
West Park
Jackson Park
Flea Flat
Yellowstone G.S.
Big Ridge
Hell Hole
Upper Basin
Lower Basin
McAfee Basin
Altonah
Mountain Home
Altonah R.S.
Boneta
Tabiona
Mt. Emmons
Uinta

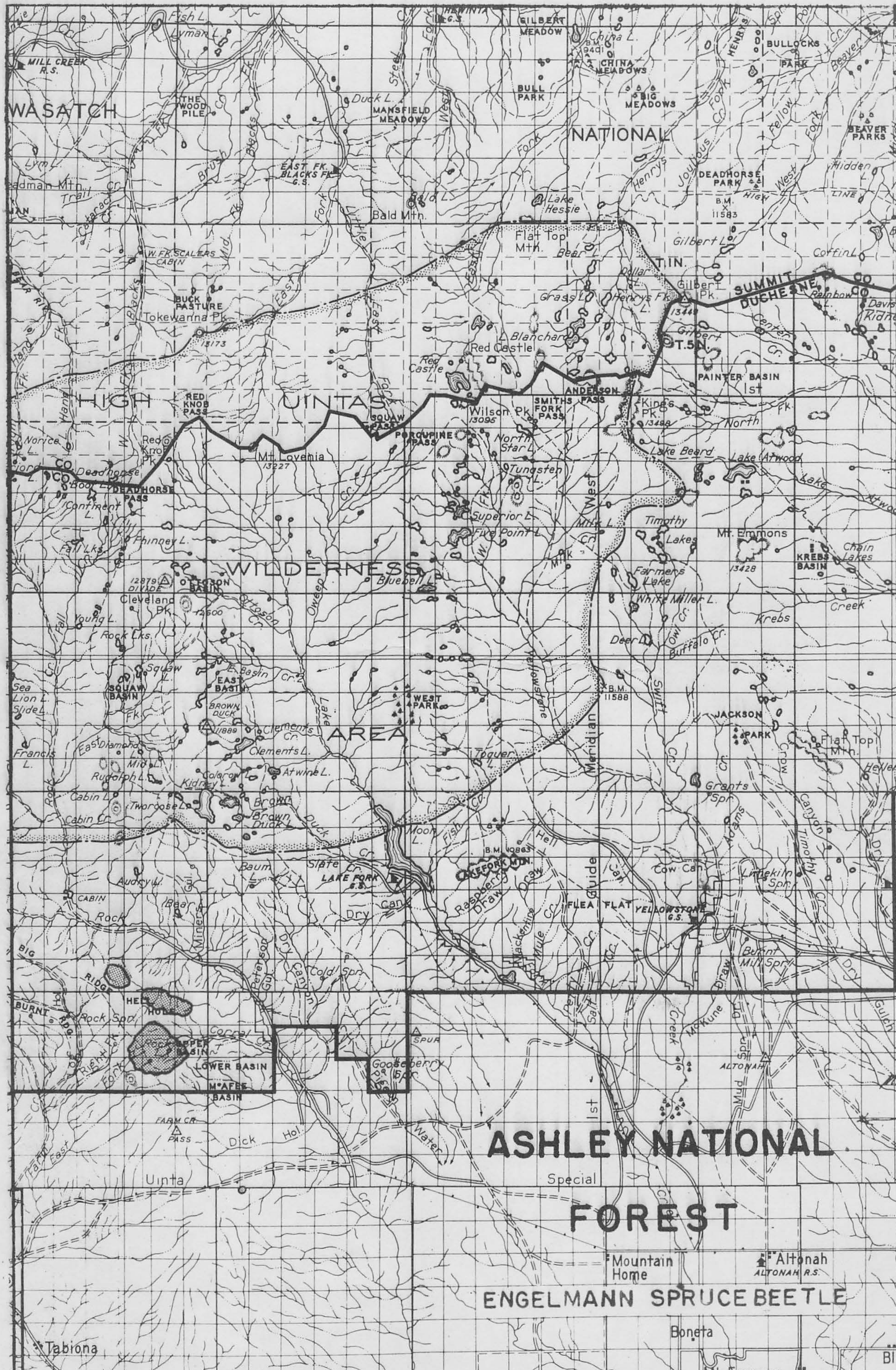
TOIYABE NATIONAL FOREST

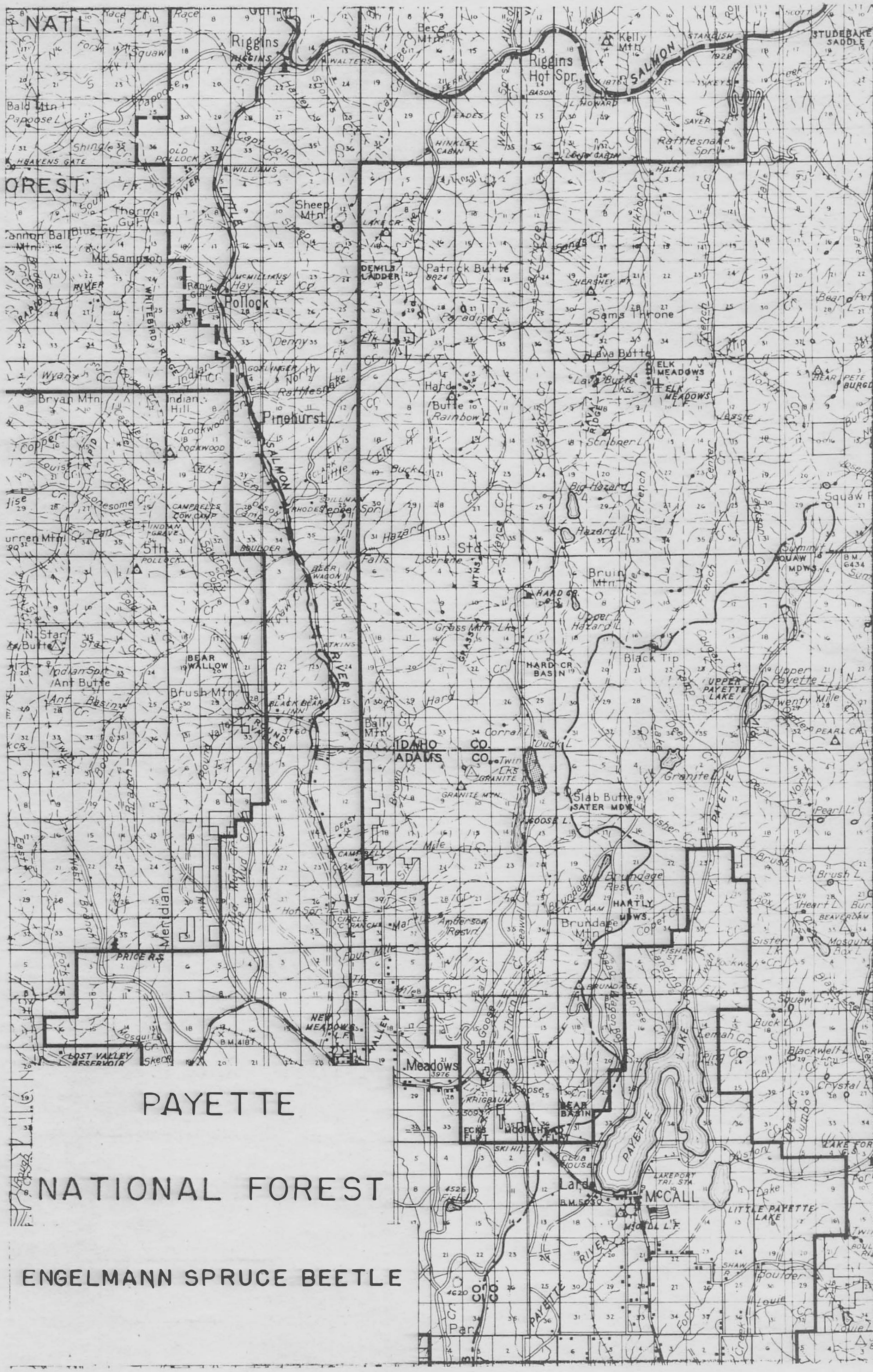
MOUNTAIN PINE BEETLE




BRIDGER
NATIONAL
FOREST
ENGELMANN SPRUCE BEETLE
NATIONAL
FOREST
T. 39 N.
T. 38 N.
T. 37 N.
T. 36 N.
T. 35 N.
T. 34 N.
TO JACKSON
Darwin Pk.
Palmer Pk.
Brewster L.
Triangle Pk
11,525
Double Top Pk
Hodges Pk.
11,130
Tosi Creek Basin
Gros Ventre (TOSI)
11,370
10,560
Pass Pk
9910
Twin Cr. Basin
Loomis Park
Klondike Hill
Little Sheep Mt.
Big Sheep Mt.
Gypsum Mtn
Battleship Mtn
Squaretop Mt.
11,679
Kenny L.
Dome Pk.
Doubletop Mt.
Rainbow L.
Flattop Mt.
Section Corner L.
Black Mt.
Roaring Basin
Osborn
Waterdog Lakes
9080
Kismet Pk
8500
Signal Hill
8420
Cow Gul.
ALEXANDER R
ALEXANDER
7993
New Fork Lakes
Willow Lake
Soda Lake
FREMONT LAKE
FREMONT G.S.
LOWER R.S.
NEW FORK LOOKOUT
KENDALL R.S.
KENDALL
BLACK BUTTE
DRESSLER R
CULBERTSON R
WARREN BRIDGE STORE
FOURTH OF JULY
JENKINS
Cora
FLAT
7825
7307
PINEDALE
PINEDALE R.S.
BAYER R
CORA
BEAVER
8312
Hay Gulch
North Beaver
Aspen Ridge
GREEN RIVER
Marsh Cr.
Willow Cr.
NEW FORK
FALER
ROCK CREEK BUTTES
BARTLETT CABIN
Tepee Cr.
Tepee Creek Ridge
Bacon Ridge
Bacon
Mosquito Lake
Lunch L.
U.S. PATROL CABIN
Mud L.
Jack Cr. Basin
Raspberry Ridge
Fish Cr.
Elk Ridge
Rock Cr.
Klondike Cr.
Lower Boulder Basin
Upper Boulder Basin
Pot Cr.
Hidden Lakes
No Name L.
Lookout
Willow Cr.
Daniel


UINTA NATIONAL
FOREST
ENGELMANN SPRUCE BEETLE
WASATCH
NAT'L
FOREST
ASHLEY
Peoa
Oakley
Marion
Kamas
Francis
Woodland
Soapstone Mtn.
Iron Mine Mtn.
Heber Mtn.
Bald Knol
Currant Cr. Pk.
Strawberry Pk.
Twin Pks.
Red Cr. Mtn.
Buckhorn Knoll
Hoyt Pk.
Haystack Mtn.
Bald Mtn.
Notch Mtn.
Mt. Watson
Potters Knoll
PROVO RIVER
SOAPSTONE G.S.
NOBLETTS G.S.
SCOTTY BASIN
SANDSTONE BASIN
HEELEY BASIN
LAMBERT MDW.
BROADHEAD MEADOWS
LIGHTNING RIDGE
R.11W.
R.10W.
R.9W.
Uinta
Base Line
WASATCH CO.
DUCHESNE CO.

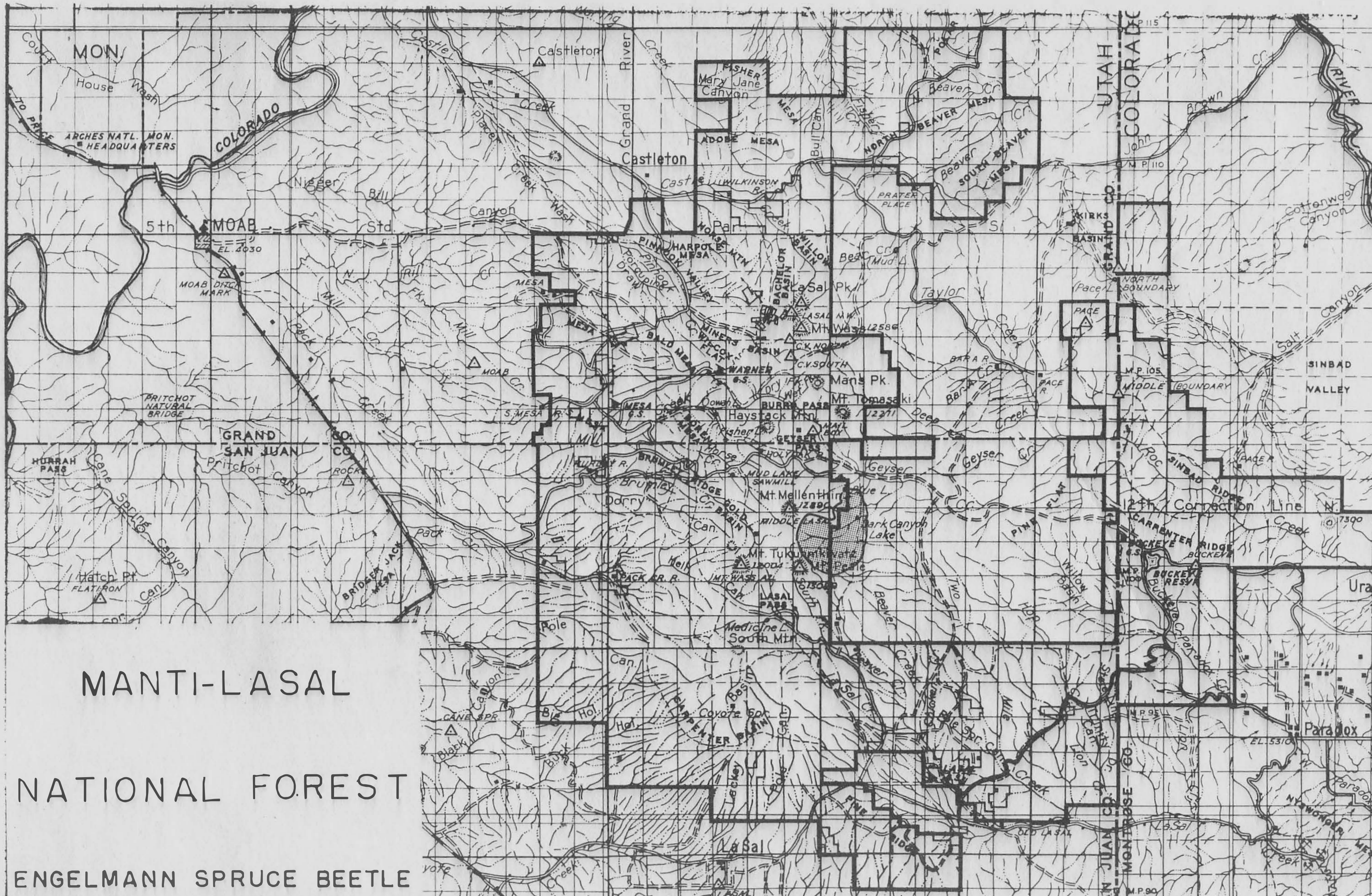

WASATCH NATIONAL
HIGH UINTAS WILDERNESS AREA
ASHLEY NATIONAL FOREST
ENGELMANN SPRUCE BEETLE
Mountain Home
Altonah
Tabiona
Boneta
Mt. Emmons



PAYETTE

NATIONAL FOREST

ENGELMANN SPRUCE BEETLE


MANTI-LASAL
NATIONAL FOREST
ENGELMANN SPRUCE BEETLE
MON.
House Wash
TO PRICE
ARCHES NATL. MON. HEADQUARTERS
COLORADO
Castleton
Grand River
Castle Creek
Castle Valley
5th Std.
MOAB
EL. 4030
MOAB DITCH MARK
PRITCHOT NATURAL BRIDGE
GRAND CO.
SAN JUAN CO.
HURRAH PASS
Pritchot Canyon
Hatch Pt.
FLATIRON
BRIDGER JACK MESA
Pack Cr.
Mill Cr.
Fisher Mesa
Mary Jane Canyon
ADOBE MESA
WILKINSON
HARPOLE MESA
PINHOOK VALLEY
Porcupine Draw
HORSE MTN
BACHELOR BASIN
WILLOW BASIN
La Sal Pk.
Mt. Waas
12586
MINERS BASIN
WILCOX FLAT
BALD MESA
WARNER G.S.
Mans Pk.
Mt. Tomasaki
12271
Haystack Mtn.
BURRO PASS
GEYSER PASS
Mt. Mellenthin
12820
MIDDLE LASAL
Dark Canyon Lake
Mt. Tukuhnikivatz
12004
Mt. Peale
13089
LASAL PASS
Medicine L.
South Mtn.
Carpenter Basin
Coyote
La Sal
OLD LASAL
NORTH BEAVER MESA
SOUTH BEAVER MESA
Beaver Cr.
PRATER PLACE
Taylor Creek
KIRKS BASIN
NORTH BOUNDARY
MIDDLE BOUNDARY
Geyser Cr.
PINE FLAT
12th Correction Line N.
CARPENTER RIDGE
BUCKEYE
BUCKEYE RESVR.
SINBAD RIDGE
SINBAD VALLEY
Salt Canyon
Cottonwood Canyon
John Brown Cr.
UTAH
COLORADO
GRAND CO.
MONTROSE CO.
SAN JUAN CO.
Paradox
EL. 5310
NYSWONGER MESA
PINE RIDGE
Uran